[U.S. Bureau of Agric. Engineering]

SOME POWER ASPECTS IN GINNING COTTON

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Widespread modernization has been accomplished in cotton gins of this country, but some ginning plants are still antiquated or in a general run-down condition, thereby having excessive power requirements on the one hand, or excessive power consumption per bale on the other, or both. Even new gins may use more power than necessary. The primary purpose of this paper is to point out some of the direct causes of these power problems and to suggest ways and means for improvement.

The farmer must make sure that his cotton reaches the gin in the best possible condition. The ginner should be capable of selling the farmer this idea, because it is the first requirement of good ginning.

Tests conducted at the U. S. Cotton Ginning Laboratories show that excessive moisture in seed cotton reduces the quality of the lint and makes it difficult to sell without penalties that may amount to as much as 25 per cent of the possible value of the bale. Green, damp or wet cotton should not be taken to the gin immediately but, if practicable, it should be stored on the farm in such manner that it may be turned and aired; or else, if wet, it may "heat" to such an extent that the quality of the lint as well as the germinating and milling qualities of the seed will be lowered.

Likewise, carefully picked cotton with the elimination of as much foreign material as possible, such as hulls, leaves, stems, etc., will materially improve the grade of lint. The time required for ginning clean, hand picked cotton may be as much as 40 per cent less than the time required for ginning snapped cotton and the power required may be as much as 16 per cent less.

The ginner should realize that he has an obligation to fulfill in employing the most modern methods and practices in ginning to insure his customer of receiving the highest possible price for his seed and lint.

CAUSES OF EXCESSIVE POWER REQUIREMENTS

The principal causes of requirements for excessive power at cotton gins may be listed as follows:

A - Tight roll ginning to obtain maximum bales per day

1/ The Cotton Ginning Laboratories of the U. S. Department of Agriculture, Stoneville, Mississippi, are jointly operated by the Bureaus of Agricultural Engineering and Agricultural Economics. Visitors are welcome.

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B - Fans and Piping
    1 - Incorrect type or size
    2 - Incorrectly installed or operated
    3 - Inefficient accessories used with the fans
C - Unnecessary auxiliaries and attachments
D - Regional bad methods of harvesting and handling cotton

CAUSES OF EXCESSIVE ENERGY CONSUMPTION

In addition to items B, C, and D above, the most common causes of excessive power consumption in cotton gins are:

E - Ginning damp or wet cotton
F - Ginning roughly harvested cotton
G - Defective saws, ribs, brushes and equipment
H - Allowing too much time to elapse between bales, while gin machinery is kept running.

FANS AND PIPING

Gin fans may become the profit thieves of a cotton gin if incorrectly selected, operated or connected to a wasteful piping system.

Table No. 1 suggests the kind of fan for each service, as recommended by the U. S. Cotton Ginning Laboratories.

Table No. 2 gives the performance that should be expected from conventional fan and separator systems as well as from Rembert-type fans (without separator) for different suctions. This table covers test results with 8 cottons at suction velocities of 3500 (weak), 4000 (good) and 4500 (strong) feet per minute. It also shows the fan speeds and time required to handle 1500 lbs. (one bale) of seed cotton during the tests.

Seed should not be blown with the cotton suction fan because it not only is wasteful in power but contaminates the seed with foreign matter and plant disease spores or fungus removed from the seed cotton being handled by it.

The correct speed of the fan depends upon the volume of air required, the resistance of the piping, the kind of fan wheel, and its diameter.

A minimum volume of air may be used if the suction velocity is approximately 4,000 to 4,500 feet per minute and if a small pipe is used. For example, tests showed that with separator systems the fan horsepower for different sized pipes at 4,500 ft. per minute velocity in an average gin was as follows:

13 inch pipe ------ 24.9 horsepower
12 inch pipe ------ 21.3 horsepower
11 inch pipe ------ 18.2 horsepower
10 inch pipe ------ 15.9 horsepower

A leaky separator will require more horsepower than that indicated above, while a good one may reduce it appreciably. Tests showed that this

ADVISABLE TYPES OF FANS FOR GINNING SERVICES AND POWER ALLOWANCES
Table 1. - FOR ECONOMICAL OPERATION

Name of Fan	Recommended Kind of Fan Wheel 1/	Allowable Fan Horsepower for an Efficient Piping System 2/	Remarks
Cotton suction with separator	A 3/ or B 4/	4 x N, 5/	Add 3 to 5 H.P. for separator
Cotton suction without separator	Rembert-type	3 x N	Used with blow-box
Airblast	A or B	5 x N	12 inch water pressure recommended
Cotton Drying Fan	A or B	(10 to 20 total)	Depends on kind of drier
Hull or trash	Steel Paddles	1 x N	"C.I." Casing
Seed-blowing	A or B	1-3/4 x N	Should use pure air
Cotton House Unloader	Depends upon system	10 to 25 total	

1/ - In either sheet steel or cast iron housing unless specially marked "C.I."
2/ - See comments on piping
3/ - A = 18-blade, shrouded, type "C", medium to high speed wheel.
4/ - B = 6 or 8-blade, unshrouded long blade slow speed wheel.
5/ - N = No. of gin stands in battery. Thus a four-stand battery should not use more than 4 x 4 = 16 horsepower for cotton suction.

COMPARATIVE POWER REQUIREMENTS FOR COTTON SUCTION FANS OF REMBERT 1/
Table 2. - AND STANDARD TYPES.

Suction Strength	Suction Velocity in feet per minute	REMBERT-TYPE FAN			STANDARD FAN		
		Speed r.p.m.	Horsepower	Time Minutes 3/	Speed r.p.m.	Horsepower 2/	Time Minutes 3/
Weak	3500	1350	5.1	16	1175	6.3	14
Good	4000	1975	9.2	11	1520	10.6	9
Strong	4500	2200	14.1	9	1840	17.6	7

1/ - Tests were made on 8 cottons. The Rembert-type was No. 35/30, wheel 23½ inches in diameter, 12 inch suction and 11 inch discharge.
2/ - Add 4 horsepower to standard fan to cover power required to operate separator
3/ - Time required to handle 1500 lbs. of seed cotton.

leakage varied from 25 per cent to 48 per cent, thus requiring the fan to handle a large volume of air in addition to that which entered the suction telescope.

Figure 1 is a diagram showing the conventional method of using a Rembert-type cotton unloader fan in a ginning plant that is equipped with a mechanical distributor. If the gins are of the brush type with independent saw and brush drive, it is customary to belt the Rembert fan to the lineshaft; and for direct connected gins to belt the fan to the "stub-shaft". In either case the fan is suspended above the shaft and blows horizontally into the blow-box.

The old suction separator may be converted into an excellent blow box by venting it through the roof or side wall of the gin with a 32 inch to 36 inch vent. A blow-box may also be made with 36 x 48 inch hardware cloth screen and 32 inch vent through the roof or side wall. The inlet adapter, for all blow-boxes should taper from round to rectangular to fit the blow-box and should be not less than 48 inches long so that the cotton will spread out uniformly and allow the air to separate from it more readily.

Fan speeds are available only in the usual open market pulley combinations. It is, therefore, desirable to have a slide valve placed four pipe diameters distance from the inlet of all fans (except the Rembert-type) 1/ so that the volume of air and resulting horsepower may be reduced to a minimum even when the fan speeds are slightly higher than desirable. Slide valves on the inlets of fans have proved to be about 25 per cent more economical in power consumption than when placed on the discharge.

DRIERS, CLEANERS, EXTRACTORS, AND OTHER AUXILIARIES

Cleaning and extracting processes, if properly used, are a distinct benefit to both the farmer and the ginner. They will materially aid the ginner in producing a higher grade of lint, and they are of great assistance to the ginner in protecting his gin stands from injury and an aid to uniform feeding and handling.

Where seed cotton is too damp to be dried naturally, there are simple and economical methods of applying artificial drying processes to cleaners and extractors which will greatly improve their operation. Several forms of cleaner-driers have been devised by the Cotton Ginning Laboratories and the ginning machinery manufacturers in such a way that the power requirements at the gin are not appreciably increased.

OPERATION OF GIN STANDS

Tight roll or dense roll ginning requires almost fifty per cent more power than loose roll ginning, calling for oversize motors. Rough

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1/ Dampers are not used on Rembert-type fans.

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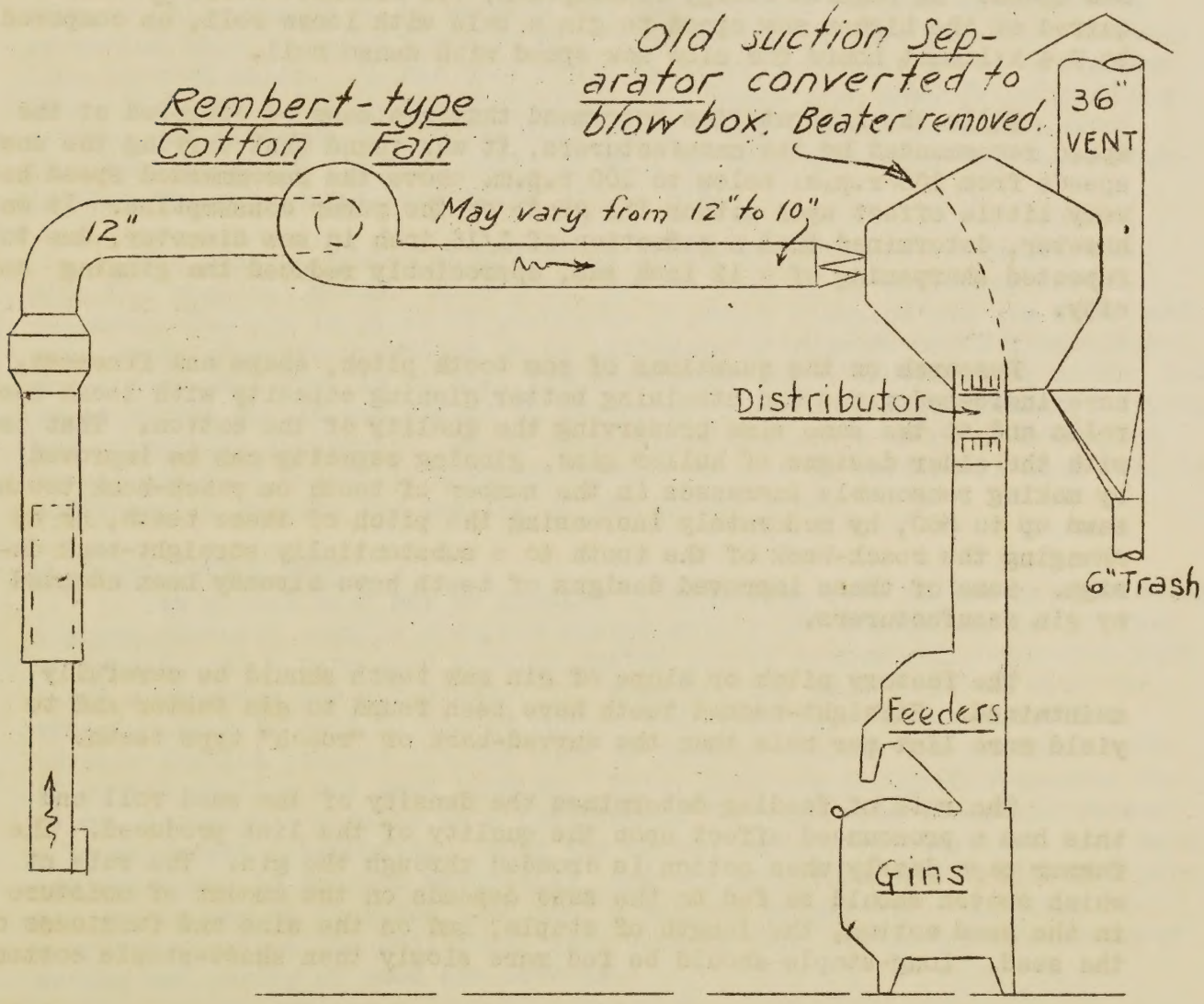
Figure 1.
Diagram showing method of employing Rembert-type cotton fan in place of suction separator and conventional fan. Any separator with 12 square feet or more of screening surface may be used as a blow-box by removing beaters and providing large vent to atmosphere. The revolving sealed-wheel dropper or vacuum wheel may be retained if desired.



ginning and lower grades result from tight roll ginning, thereby causing heavy losses to the cotton farmer.

Saw speeds are secondary in their effect, and for gins which mote by gravity may be as high as 600 r.p.m., while 700 r.p.m. is recommended for high speed centrifugal moting gins. The increased capacity resulting from these saw speeds usually permits loose roll ginning and well-cleaned seed without decrease in bales per day turnout previously obtained from denser roll (medium) ginning at low saw speeds.

On ginning cottons shorter than 1-1/16 inches, an average of 10.8 horsepower was required at high speed with loose roll for feeder, saws and brush, while 15 horsepower was necessary at slow speed with tight roll.

Tests showed no significant increase in power required for the higher saw speed. As regards energy consumption, 7.5 kilowatt hours 1/ were required at the higher saw speed to gin a bale with loose roll, as compared to 9.4 kilowatt hours for slow saw speed with dense roll.

While the Laboratories recommend that gin saws be operated at the speed recommended by the manufacturers, it was found that varying the saw speeds from 100 r.p.m. below to 100 r.p.m. above the recommended speed had very little effect upon either the grade or the power consumption. It was, however, determined that a reduction of 1/16 inch in saw diameter, due to repeated sharpening of a 12 inch saw, appreciably reduced the ginning capacity.

Research on the questions of saw tooth pitch, shape and fineness, have indicated means for attaining better ginning capacity with loose seed rolls and at the same time preserving the quality of the cotton. That is, with the older designs of huller gins, ginning capacity can be improved by making reasonable increases in the number of teeth on roach-back tooth saws up to 300, by moderately increasing the pitch of these teeth, or by changing the roach-back of the tooth to a substantially straight-back design. Some of these improved designs of teeth have already been adopted by gin manufacturers.

The factory pitch or slope of gin saw teeth should be carefully maintained. Straight-backed teeth have been found to gin faster and to yield more lint per bale than the curved-back or "roach" type teeth.

The rate of feeding determines the density of the seed roll and this has a pronounced effect upon the quality of the lint produced. The farmer pays dearly when cotton is crowded through the gin. The rate at which cotton should be fed to the saws depends on the amount of moisture in the seed cotton, the length of staple, and on the size and fuzziness of the seed. Long-staple should be fed more slowly than short-staple cotton.

1/ Energy consumption of one ginning unit comprising gin stand saws, brush and feeder.

The ginner who is feeding the stands at the lowest rate and still getting a rough sample can often improve it by slowing down his feeder drive. Setting the seed board wide open also helps because it permits a good discharge of seed and thus contributes to a loose seed roll.

Samples ginned with a loose seed roll averaged from one-third to a full grade better than those ginned with a tight seed roll. On some cottons the resulting lint was sometimes two full grades better. A tight seed roll not only lowers the ginning preparation, but affects the observed color and leaf, factors of grade.

EFFICIENT GINNING

Power costs may be further minimized by an alert ginner who does not permit the gin to run idle for extended periods between bales. Careful timing on his part together with the feeding of enough cotton to the overflow to allow wagons to be weighed out and new ones to move up while the preceding bale is being finished will make an appreciable reduction in lost time between bales. It has been shown by tests that when a gin is running idle, its cotton fan is actually using more power than when it is handling cotton; and although the idling load for a ginning plant is seldom more than two-thirds of its full load, it will be seen that each minute is costly when the gin is not performing useful work.

The ginning system should be as simple as possible, commensurable with the regional needs. Horsepower may be reduced by employing unit extractor-feeders in place of ponderous overhead cleaners and big drum feeders. Many gins are operating on an allowance of from 20 to 23 horsepower per gin stand. That is to say, the horsepower for a conventional modern four-stand outfit should not exceed 92 horsepower even with good cleaning, drying and extracting equipment. Heavy unnecessary auxiliary or power consuming items should be carefully scrutinized and cut out of service if they fail to sufficiently improve the quality of the ginned lint.

HANDLING COTTON SEED

The ginned seed may be handled by conveying with augurs or by blowing. A screw conveyor usually requires approximately 1/2 horsepower per 10 feet of length, and a pure seed blowing system may be economically operated with 1-3/4 horsepower per gin stand. If, however, the seed is blown with the same fan that is used to unload the cotton, this power requirement is usually doubled because the fan must be speeded to suit the combined needs of cotton suction and seed blowing. This, when coupled with over-size seed pipes, invariably results in a requirement for excessive power and causes a heavy energy consumption. When the cotton suction fan does not blow seed, its speed may be dropped materially, and the seed blowing fan with its pure air supply may be operated also with a minimum horsepower. Although such a system requires the additional seed blowing fan, its advantages in power saving and purity of seed are obvious.

LINE SHAFTING AND BEARINGS

In many of our older ginning plants, the line shafting is mounted on wood columns and with plain bearings. As these wood columns and other wood framing have dried out, it doubtless has warped and gotten out of alignment so that strains have been produced in bearings to the point where excessive friction has been caused with a consequent increase in the power required to drive the ginning machinery.

OTHER DATA ON GINS

During the past several years, records 1/ have been kept of the power requirements of 59 ginning plants, and it has been found that the best of these plants gin cotton with a power consumption of 10 kilowatt hours per bale and the worst plant required 41 kilowatt hours per bale. The average for all of the gins on which records were kept is 17.9 kilowatt hours per bale. These ginning plants ranged from old, dilapidated plants to the newest and most modern plants available. However, the most modern of these plants did not consume the least number of kilowatt hours per bale. This would seem to indicate that a ginning plant does not necessarily have to be the newest and most modern in order to gin cotton with a minimum power requirement.

CONCLUSIONS AND RECOMMENDATIONS

It is concluded from the foregoing that:

1. The farmer can assist the ginner in producing a much higher quality of lint by being more careful of his harvesting and handling methods.
2. The ginner can produce a higher quality of lint by following up to date practices in ginning cotton.
3. From 25 to 50 per cent of the power required to gin cotton can be saved by modernizing the gin and ginning methods.

It is recommended:

1. That the ginner himself, or his mechanic, visit the Cotton Ginning Laboratories at Stoneville, Mississippi.
2. That the ginner consult with the manufacturers of ginning equipment in regard to modernizing his plant.
3. That the ginner consult with the Cotton Ginning Specialist located at his state university.
4. That the ginner consult with representatives of the electric service institution furnishing power.

REFERENCE LITERATURE

The following publications of the U. S. Department of Agriculture are available for free distribution as long as the supply lasts and may

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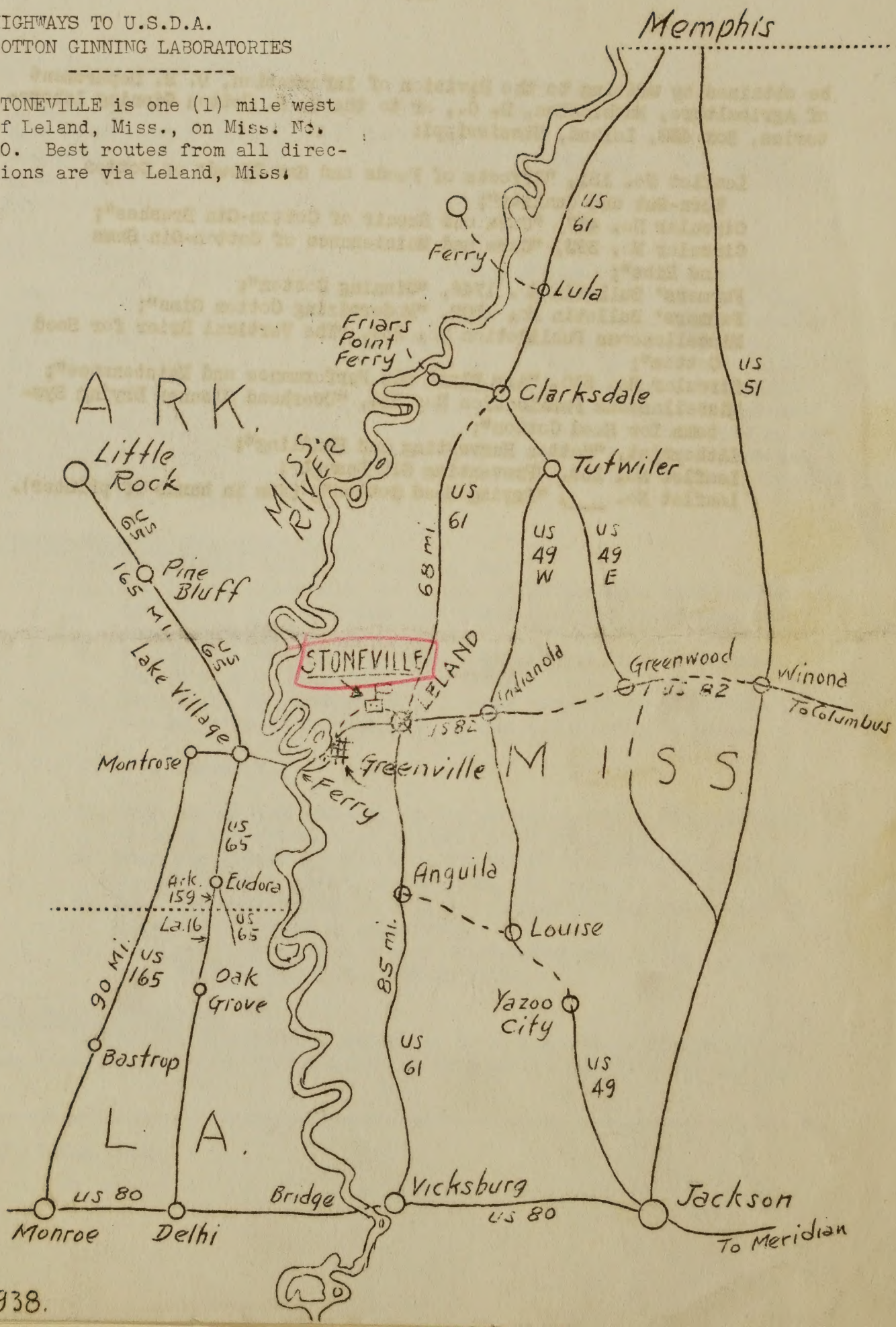
1/ T.V.A. data.

be obtained by writing to the Division of Information, U. S, Department of Agriculture, Washington, D. C., or to the U. S. Cotton Ginning Laboratories, Box 428, Leland, Mississippi:

Leaflet No. 151, "Effects of Feeds and Saw Speeds on Cotton Turn-Out and Quality";
Circular No. 467, "Care and Repair of Cotton-Gin Brushes";
Circular No. 393, "Care and Maintenance of Cotton-Gin Saws and Ribs";
Farmers' Bulletin No. 1748, "Ginning Cotton";
Farmers' Bulletin No. 1802, "Modernizing Cotton Gins";
Miscellaneous Publication No. 239, "The Vertical Drier for Seed Cotton";
Circular No. 510, "Air Blast Gin Performance and Maintenance";
Miscellaneous Publication No. 314, "Overhead Cleaner Drying Systems for Seed Cotton";
Lithoprint, "Cotton Harvesting and Handling";
Leaflet No. 169, "Preventing Gin Damage";
Leaflet No. ___, "Drying Seed Cotton", (Now in hands of printer).

HIGHWAYS TO U.S.D.A.
COTTON GINNING LABORATORIES

STONEVILLE is one (1) mile west of Leland, Miss., on Miss. No. 10. Best routes from all directions are via Leland, Miss.



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